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IoT Based Smart Irrigation Tracking and Management System Using Arduino UNO Microcontroller

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ABSTRACT

Every region of India has a significant agricultural sector. The scope of agriculture is reduced across all of India due to a rapid shift in climate and lesser rainfall. The most productive farming should be done without wasting any water. In the conventional technique, more water than what is required by the crop is used to irrigate the area. Modern irrigation systems like drip irrigation, sprinkle irrigation, etc. can reduce water waste. A sophisticated irrigation device's execution and design are widely accepted in a variety of settings, with the electric device offering the most dependable pricing performance. This paper proposes an IOT based smart irrigation tracking and management system using Arduino Uno microcontroller. The low-cost dependable gadget is designed to irrigate areas when there is a need for water and to provide data. This paper uses Node-Microcontroller ESP8266, DHT11 sensor and soil moisture sensor. The DHT11 sensor has a humidity measuring component and a NTC temperature component. The soil moisture sensor used for measuring the volumetric water content in the soil. The proposed smart irrigation system reduces wastage of water than the traditional process. The information is sent to the farmers by using cloud website called Blynk app. All the data is uploaded by Wi-Fi module inbuilt in microcontroller to Blynk app cloud database.

Keywords: IOT, Node-Microcontroller ESP8266, DHT11 Sensor, Voltage Sensor, Soil Moisture Sensor, Blynk App.

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1 Introduction

Agriculture must adhere to the global trend toward new uses and technology. Agriculture is regarded as the cradle of life for the human species since it is the main source of food grains and raw materials [1]. Since farming is the primary source of food and plays a crucial role in the economic growth of any country, it is a need for all people [2]. It is crucial to maximize the effectiveness of irrigation systems, some of which traditional farmers have long used, in order to boost productivity per crop. Farmers may water their agricultural area using two basic techniques: irrigation and Rainfed farming. Direct rainfall is necessary for Rainfed farming since there is less chance of contamination there. However, it struggles with inadequate water levels when there is little or no rainfall. The use of irrigation systems aids in agricultural production while using the least amount of water, protecting plants from frost, and controlling dust [3]. The technology was generated to employ a wireless sensor network to collect information about temperature, understanding the nature of the farm and the monitoring equipment requires knowledge about humidity, moisture levels, and the sensor node [4]. Gather and examine this data from the sensor nodes, then store them on the management server and send emergency alerts. The gathered information reveals details on numerous environmental elements. Not all environmental parameters can be monitored in order to enhance agricultural productivity [5]. Indeed, societal worries about the environment's effects and food safety have increased interest in cutting-edge technology that are meant to be helpful in this situation [6]. Machine vision systems provide high throughput monitoring, analysis, and production in an autonomous way without the need for human interaction. Different biological characteristics of a plant can be revealed by its growth pattern under various environmental situations [7]. Food security is under concern as food crops are being used for the production of biofuels, bioenergy, and other industrial purposes. The burden on already limited agricultural resources is rising as a result of these demands [8] Precision agriculture benefits significantly from the Internet of Things (IoT). The term "Internet of Things" refers to a network of physical objects, such as vehicles, buildings, and other items, that are linked to the internet and equipped with electronics, software, actuators, sensors, and network links [9]. One of the most effective methods to accomplish these aims is through the use of technologies that enable precision agriculture, which measure, monitor, and react to site-specific variability in the field [10].

The remainder of the paper is structured as follows: Section II offers a deep overview of the prior works. Section III gives insight and proposes an explanation. Section IV highlights the results, and Section V describes the conclusion part.

2 Recent Works

Sen Wang *et al* (2019) [11] have proposed generative method for retargeting human-robot motion, from to accomplish motion tracking and retargeting in a single framework. By using the SMPL model with a single RGBD picture, a parametric HUMROB template has been

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developed. The template has integrated robot setups. The optimization process has also been made to impose the combined restriction of the target robots and stability restrictions. The SMPL model is more effective and practical for retargeting systems.

Maria Rousi *et al* (2021) [12] have developed a framework for helping the European Common Agricultural Policy execute rule sets by combining supervised learning for crop type classification on time-series of satellite images with semantic web and linked data techniques. The provided methodology's primary advances are its capacity to be reused and transferred, the use of mostly available data, and the fact that it requires little adjustment when used in various places. Future studies will examine comparable datasets that relate to different locations in order to apply the laws of agricultural policies.

Hatem *et al* (2019) [13] have described the concept of an edge-fog-cloud architecture introduced in the smart agriculture system, Compared to the conventional cloud-based architecture, this approach resolved real-time processing problems by decreasing energy consumption, CO2 emissions, and network traffic. Due to the use of edge and fog layers in this design, the computational burden and volume of data transferred to and from the cloud were both greatly decreased. To further grasp the capabilities, the technique must be expanded to a distributed, real-world agricultural setting, taking into account machine learning and decision-making algorithms.

Anusha Vangala *et al* (2020) [14] have presented the growth of the Internet of Things (IoT) and blockchain technology as two quickly developing disciplines that can improve the status of the food chain as it stands today. A thorough analysis of the available literature was conducted to examine the most recent developments in information security methods that use blockchain technology. Although such an assault has not occurred before, present systems are not prepared to handle such situations.

Syeda Iqra Hassan *et al* (2021) [15] have recommended the global population is growing quickly and will double in the future decades. As a result, there is a corresponding rise in food demand. Automation of agricultural processes using sophisticated control tactics has been shown to boost crop output and strengthen soil fertility. Wellness of crops visualization, incorporated GIS mapping, simplicity of use, and the prospect of increased yields, and time savings are some of the key benefits of using exploitation drones. Additionally, it is challenging to execute sophisticated and complicated algorithms because of the low power and memory availability.

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3 Proposed Work Explanation

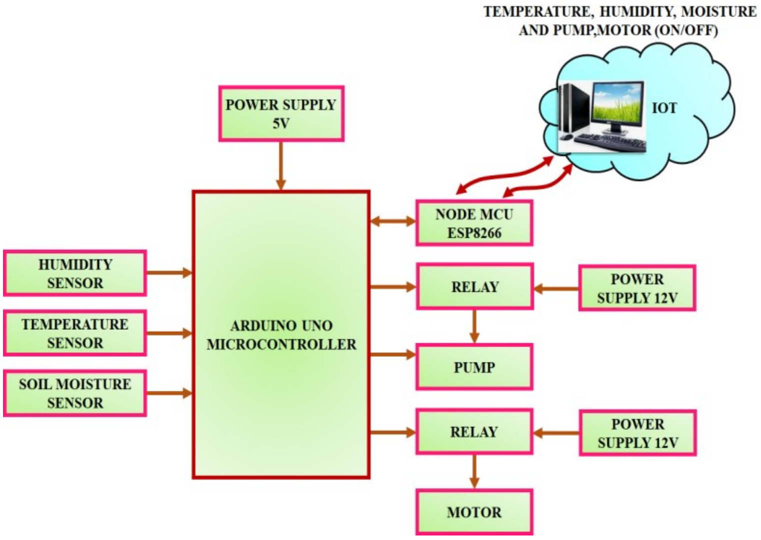

Figure 1: *Block Diagram for the Smart Irrigation Monitoring*

Figure 1 shows the Smart Irrigation Monitoring System's block diagram. In this paper, an Arduino Uno microcontroller-based smart irrigation monitoring and control system is proposed. The affordable, dependable device's functions include data collection and irrigation of regions when water is needed. The Node-Microcontroller ESP8266, DHT11 sensor, and soil moisture sensor are used in this paper. Both a Humidity sensor and an NTC Temperature sensor are included in the DHT11 sensor. The sensor for detecting soil moisture, which measures the volumetric water content of the soil. The proposed intelligent irrigation system uses less water than the conventional method. The farmers receive the information via the cloud-based Blynk app website. The Blynk app's cloud server receives all the data via an upload from the Wi-Fi module included within the microcontroller.

3.1 Arduino UNO

The widely used Arduino electronics platform is made up of open source hardware and software. An ATmega328-based circuit serves as the microcontroller. Its characteristics include a 16 MHz ceramic resonator, six analog inputs, a USB port, a power connection, an ICSP header, and a reset button.

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3.2 Node MCU ESP8266

Figure 2: *Node MCU ESP8266*

Figure 2 shows the pin diagram of Node MCU ESP8266. The Node MCU is a freely available software and hardware development platform based on the ESP8266, a relatively inexpensive System-on-a-Chip (SoC).The ESP8266 has the flexibility of outsourcing are all Wi-Fi networking tasks from another application processor or hosting a software program.

3.3 DTH11 Sensor

Figure 3: *DTH11 Sensor*

Figure 3 provides DTH11 Sensor. This straightforward and low-cost digital temperature and humidity sensor is called the DHT-11. It utilizes a thermistor and a capacitive humidity sensor to monitor the ambient air, and it delivers a digital signal on the data port without the requirement for analog input inputs. Digital temperature and humidity sensors like the DHT11 are inexpensive. This sensor is used for a variety of purposes, such as detecting humidity and temperature levels in HVAC devices. These sensors are used by weather stations as well to forecast weather conditions. This sensor is employed in workplaces, motor vehicles, cultural institutions, greenhouses, and businesses for safety reasons and to assess humidity levels.

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3.4 Soil Moisture Sensor

One sort of sensor used to determine the overall amount of liquid in the substrate is the soil moisture sensor. Before sample weighting and drying, the initial gravity technique dimension of soil moisture must be removed. These sensors are often employed to measure the volumetric water content, while another set of sensors determines the water potential, a brand-new measure of moisture in soils. Figure 4 gives Soil Moisture Sensor.

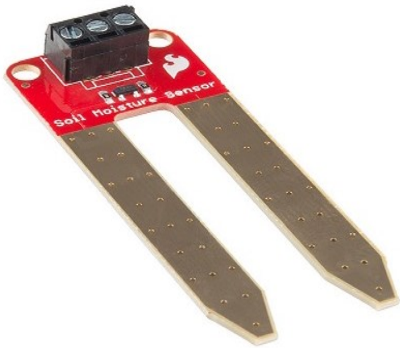

Figure 4: *Soil Moisture Sensor*

3.5 Relay Module

Relays are low-voltage electrical switches that turn on and off, allowing electricity to flow through it or not. The generally closed option is used when you want the relay to be shut off by default, which means that current will flow until you provide a signal to the relay module telling it to open the circuit and turn off the current. The opposite is true of the arrangement that is generally open. The Relay Module is presented in Figure 6.

Figure 5: *Relay Module*

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3.6 Motor

Direct current electrical energy is converted into mechanical energy by any of a class of rotating electrical appliances referred to as DC motors. The most common types are those that rely on magnetic field forces. Nearly all varieties of an electromechanical or electrical mechanism integrated into DC motors allows the driver to sporadically alter the direction of the motor's current flow.

3.7 Blynk App

Arduino, Raspberry Pi, and Node MCU can all be controlled from Android and iOS mobile devices using the Internet of Things (IoT) platform Blynk. By gathering and delivering the correct address on the easily accessible widgets, a graphical user interface (GUI) or human machine interface (HMI) is developed with the use of this application. Without creating any code, it is possible to control ESP32 or Arduino pins with mobile devices using the Blynk library. Another option is to distribute a thought across associates or clients, allowing them access to connected gadgets while preventing them from editing the work. The Blynk app is displayed in Figure 6.

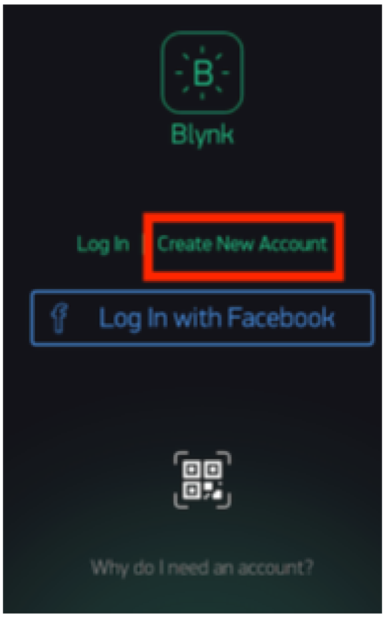

Figure 6: *Blynk app*

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4 Results and Discussion

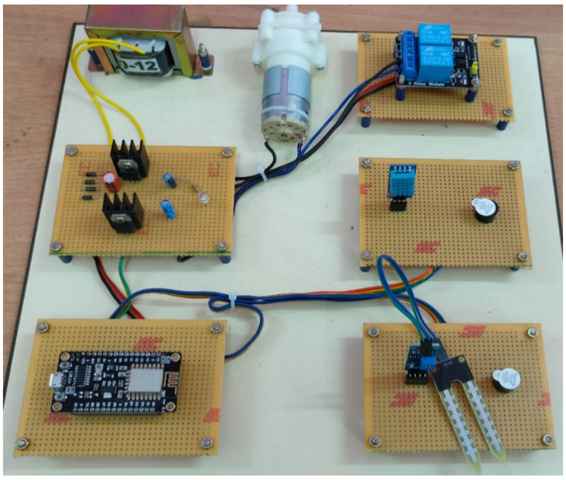

Figure 7: *Hardware View*

Figure 7 shows the hardware view for smart irrigation. The ground is irrigated using a conventional approach with more water than the crop need. Water waste is avoided with the use of modern irrigation systems. The most recent technology, nevertheless significantly reduce the risk involved in agricultural production and offer effective water resources. The implementation of a low-cost IoT-based smart irrigation system is the aim of this paper. The low-cost device is made so that farmers is monitor the field by visiting the BLYNK app channel link and receiving the information obtained by the device via a cloud-based webpage called BLYNK app. The Node-Microcontroller ESP8266, DHT11 sensor, and soil moisture sensor are employed in this paper. The Wi-Fi module included inside the microcontroller transmits information to the cloud database of the BLYNK app.

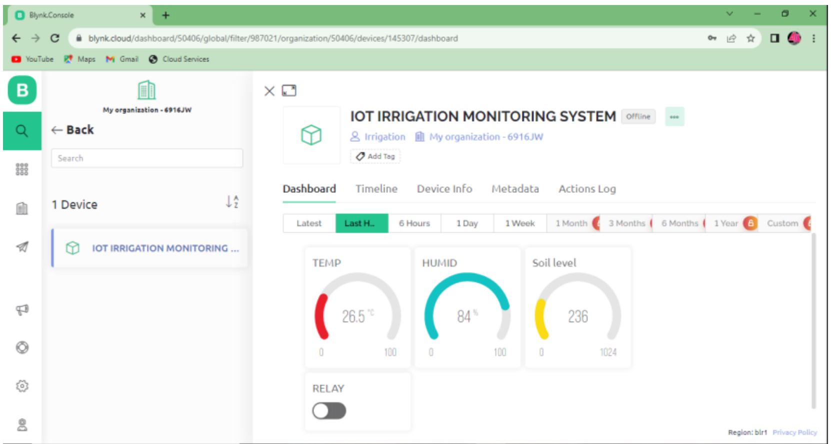

Figure 8: *Result obtained on BLYNK app*

Figure 8 illustrates the outcome of temperature, humidity and soil moisture received in the BLYNK app.

5 Conclusion

This paper develops a smart irrigation system that is affordable and usable on an agricultural field by a middle-class farmer. The sensor unit and the Arduino microcontroller unit make up this paper. A Wi-Fi module by the name of NODEMCU is integrated with the microcontroller unit in order to enhance data processing in the cloud storage system. Here, measurements of soil moisture, temperature, and humidity are obtained using the Node-Microcontroller ESP8266, a soil moisture sensor, and a DHT11 sensor. A DHT11 sensor is used to gauge the humidity and temperature of the field. This information is used by the farmer to decide if the climate and atmospheric conditions are good or bad for their crop. Whether the soil is damp or dry is determined by Moisture sensor. The microcontroller transfer the info that was gathered by the sensor units to the webpage with mobile app. The farmer may monitor and control the irrigation system from anywhere at any time by utilizing an Android mobile application.

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